WHAT IS CLAIMED IS:

Sub A1

1. An energy-trap thickness extensional vibration mode piezoelectric resonator, comprising:

a piezoelectric body including a plurality of piezoelectric layers and uniformly polarized in a thickness direction thereof; and

N number of internal electrodes, where N is an integer equal to 3 to 5, arranged in the piezoelectric body on top of each other with the piezoelectric layers disposed therebetween; wherein

the piezoelectric body vibrates in an (N-1)th higher-order mode of a thickness extensional vibration mode generated by applying electric fields of opposite polarity alternately in the direction of thickness to piezoelectric layers between internal electrodes, and when the thickness of a piezoelectric layer between adjacent internal electrodes in the direction of thickness is denoted by D and the thicknesses of a first and second piezoelectric layer outside the outermost internal electrodes in the direction of thickness are denoted by D_1 and D_2, the following relationships are satisfied: $0.50 \leq (D_1 + D_2)/2D \leq 1.00$ at N = 3, $0.50 \leq (D_1 + D_2)/2D \leq 0.90$ at N = 4, and $0.50 \leq (D_1 + D_2)/2D \leq 0.80$ at N = 5.

2. An energy trap thickness extensional vibration mode piezoelectric resonator according to claim 1, wherein the N number of internal electrodes include substantially linear electrodes and intersect with each other through piezoelectric layers, and wherein the intersection portion constitutes an energy trap type piezoelectric vibration portion.

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3. An energy-trap thickness extensional vibration mode piezoelectric resonator, comprising:

a piezoelectric body including a plurality of piezoelectric layers and uniformly polarized in a thickness direction thereof; and

N number of internal electrodes, where N is an integer equal to 3 to 5, arranged in the piezoelectric body on top of each other with the piezoelectric layers disposed therebetween; wherein

the piezoelectric body vibrates in an (N-1)th higher-order mode of a thickness extensional vibration mode generated by applying electric fields of opposite polarity alternately in the direction of thickness to piezoelectric layers between internal electrodes, and when the thickness of a piezoelectric layer between adjacent internal electrodes in the direction of thickness is denoted by D and

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the thicknesses of a first and second piezoelectric layer outside the outermost internal electrodes in the direction of thickness are denoted by D_1 and D_2, the following relationships are satisfied: $0.10 \leq (D_1 + D_2)/2D \leq 0.80$ at $N = 3$, $0.10 \leq (D_1 + D_2)/2D \leq 0.50$ at $N = 4$, and $0.10 \leq (D_1 + D_2)/2D \leq 0.45$ at $N = 5$.

4. An energy trap thickness extensional vibration mode piezoelectric resonator according to claim 3, wherein the N number of internal electrodes include substantially linear electrodes and intersect with each other through piezoelectric layers, and wherein the intersection portion constitutes an energy trap type piezoelectric vibration portion.

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5. An energy-trap thickness extensional vibration mode piezoelectric resonator, the piezoelectric resonator comprising:

a piezoelectric body including a plurality of piezoelectric layers; and

N number of internal electrodes, wherein N is an integer equal to 3 to 5, disposed in the piezoelectric body and stacked on each other with the piezoelectric layers disposed therebetween; wherein

the piezoelectric body vibrates in an (N-1)th higher-

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order mode of a thickness extensional vibration mode and piezoelectric layers located between the internal electrodes are polarized in opposite direction alternately in the direction of thickness, and when the thickness of a piezoelectric layer between adjacent internal electrodes in the direction of thickness is denoted by D and the thicknesses of a first and second piezoelectric layer outside the outermost internal electrodes in the direction of thickness are denoted by D_1 and D_2, the following relationships are satisfied: $0.60 \leq (D_1 + D_2)/2D \leq 1.10$ at $N = 3$, $0.65 \leq (D_1 + D_2)/2D \leq 0.90$ at $N = 4$, and $0.60 \leq (D_1 + D_2)/2D \leq 0.80$ at $N = 5$.

6. An energy trap thickness extensional vibration mode piezoelectric resonator according to claim 5, wherein the N number of internal electrodes include substantially linear electrodes and intersect with each other through piezoelectric layers, and wherein the intersection portion constitutes an energy trap type piezoelectric vibration portion.

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7. An energy-trap thickness extensional vibration mode piezoelectric resonator, comprising:

a piezoelectric body including a plurality of piezoelectric layers; and

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N number of internal electrodes, wherein N is an integer equal to 3 to 5, disposed in the piezoelectric body and stacked on each other with the piezoelectric layers disposed therebetween; wherein

the piezoelectric body vibrates in an (N-1)th higher-order mode of a thickness extensional vibration mode and piezoelectric layers located between the internal electrodes are polarized in opposite direction alternately in the direction of thickness, and when the thickness of a piezoelectric layer between adjacent internal electrodes in the direction of thickness is denoted by D and the thicknesses of a first and second piezoelectric layer outside the outermost internal electrodes in the direction of thickness are denoted by D_1 and D_2, the following relationships are satisfied: $0.10 \leq (D_1 + D_2)/2D \leq 1.10$ at $N = 3$, $0.10 \leq (D_1 + D_2)/2D \leq 0.90$ at $N = 4$, and $0.10 \leq (D_1 + D_2)/2D \leq 0.80$ at $N = 5$.

8. An energy trap thickness extensional vibration mode piezoelectric resonator according to claim 7, wherein the N number of internal electrodes include substantially linear electrodes and intersect with each other through piezoelectric layers, and wherein the intersection portion constitutes an energy trap type piezoelectric vibration portion.

9. A ladder-type filter comprising

a series-arm resonator including a thickness extensional vibration mode piezoelectric resonator according to claim 1; and

a parallel-arm resonator.

10. A ladder-type filter comprising

a series-arm resonator including a thickness extensional vibration mode piezoelectric resonator according to claim 5; and

a parallel-arm resonator.

11. A ladder-type filter comprising

a parallel-arm resonator including a thickness extensional vibration mode piezoelectric resonator according to claim 3; and

a series-arm resonator.

12. A ladder-type filter comprising

a parallel-arm resonator including a thickness extensional vibration mode piezoelectric resonator according to claim 7; and

a series-arm resonator.

13. A piezoelectric resonator component comprising:

a thickness extensional vibration mode piezoelectric resonator according to claim 1;

a case substrate bonded to the piezoelectric resonator so as to define a space for allowing the piezoelectric resonator to vibrate; and

a conductive cap bonded to the case substrate so as to enclose the piezoelectric resonator.

14. A piezoelectric resonator component comprising:

a thickness extensional vibration mode piezoelectric resonator according to claim 3;

a case substrate bonded to the piezoelectric resonator so as to define a space for allowing the piezoelectric resonator to vibrate; and

a conductive cap bonded to the case substrate so as to enclose the piezoelectric resonator.

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~~14~~. A piezoelectric resonator component comprising:

a thickness extensional vibration mode piezoelectric resonator according to claim 5;

a case substrate bonded to the piezoelectric resonator so as to define a space for allowing the piezoelectric resonator to vibrate;

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piezoelectric resonator to vibrate; and

a conductive cap bonded to the case substrate so as to enclose the piezoelectric resonator.

16. A piezoelectric resonator component comprising:

a thickness extensional vibration mode piezoelectric resonator according to claim 7;

a case substrate bonded to the piezoelectric resonator so as to define a space for allowing the piezoelectric resonator to vibrate; and

a conductive cap bonded to the case substrate so as to enclose the piezoelectric resonator.